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Hospitalization Rates Before and After Adult-to-Adult Living Donor or Deceased Donor Liver Transplantation,,[1,2,3]

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Abstract

Objective—To compare rates of hospitalization before and after adult-to-adult living donor liver transplant (LDLT) and deceased donor liver transplant (DDLT).

Summary background data—LDLT recipients have been reported to have lower mortality but a higher complication rate than DDLT recipients. The higher complication rate may be associated with greater consumption of inpatient hospital resources and a higher burden of disease for LDLT recipients.

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Methods—Data from the 9-center Adult-to-Adult Living Donor Liver Transplantation (A2ALL) retrospective cohort study were analyzed to determine pre-transplant, transplant, and post-transplant hospitalizations among LDLT candidates (potential living donor was evaluated) who received LDLT or DDLT. Hospital days and admission rates for LDLT and DDLT patients were calculated per patient-year at risk, starting from the date of initial potential donor history and physical examination. Rates were compared using overdispersed Poisson regression models.

Results—Among 806 candidates, 384 received LDLT and 215 received DDLT. In addition to the 599 transplants, there were 1913 recipient hospitalizations (485 pre-transplant; 1428 post-transplant). Mean DDLT recipient pre-transplant, transplant, and post-transplant lengths of stay were 5.8±6.3, 27.0±32.6, and 9.0±14.1 days, respectively, and for LDLT were 4.1±3.7, 21.4±24.3, and 7.8±11.4 days, respectively. Compared to DDLT, LDLT recipients had significantly lower adjusted pre-transplant hospital day and admission rates, but significantly higher post-transplant rates. Significantly higher LDLT admission rates were observed for biliary tract morbidity throughout the second post-transplant year. Overall hospitalization rates starting from the point of potential donor evaluation were significantly higher for eventual recipients of LDLT.

Conclusions—LDLT recipients, despite lower acuity of disease, have higher hospitalization requirements when compared to DDLT recipients. Continuing efforts are warranted to reduce the incidence of complications requiring post-LDLT inpatient admission, with particular emphasis on biliary tract issues.

INTRODUCTION

Liver transplantation is performed for otherwise irremediable end-stage liver disease. Not surprisingly, candidates with complications of advanced liver disease utilize substantial inpatient hospital resources both before and after liver transplantation (1). Measures of the burden of disease borne by these patients are important adjuncts to mortality metrics and post-transplant graft survival statistics.

In the specific case of patients who pursue living donor liver transplantation (LDLT), little attention has been directed to hospitalization rates, particularly in relation to comparable patients who do not receive an LDLT, but may subsequently receive a deceased donor liver transplant (DDLT). Among liver transplant candidates who pursue the LDLT option, defined as having a potential living donor come forward for evaluation, only about one-half eventually receive LDLT, while the remaining half is about evenly divided between those who receive DDLT and those who never receive a transplant at all (2). In this study, we studied hospital admission rates and rates of inpatient hospital days in a well-characterized observational cohort of patients with chronic liver disease from the Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL).

METHODS

Data Sources

Candidate and donor data were provided by the nine participating A2ALL transplant centers based on a common protocol. The A2ALL retrospective observational cohort study included 806 patients with chronic liver disease who had at least one potential living donor evaluated between 1/1/98 and 2/28/03. SRTR data were used under a data use agreement to supplement A2ALL data for death date, transplant dates, donor type, cold ischemia time, height, weight, and Model for End-stage Liver Disease (MELD). Patient entry occurred at the date that each potential LDLT candidate's first potential living donor presented for their initial donor history and physical examination.

There were 2543 hospitalizations recorded for these patients during the study period. Pairs of adjacent hospitalizations (admit date same as previous discharge date) in which the first hospitalization ended in a transfer were combined (n=27 pairs), two hospitalizations that overlapped other hospitalizations and were longer than 365 days were excluded, and two whose dates of admission and discharge were entirely nested were excluded, leaving 2512 hospitalizations available for analysis.

Statistical Methods

Patients were classified as having received a DDLT, LDLT or no transplant during the study. Domino transplants (n=2) and split liver transplants (n=10) were counted as DDLTs. Procedures aborted due to recipient reasons (n=6) were counted as transplants. LDLT recipients were further classified as having received an LDLT when the center was “more experienced” (center case numbers 21 and above) or “less experienced” (center case numbers 1–20). Hospitalizations following transplantation were classified as being due to biliary or non-biliary reasons based on the discharge diagnosis.

Days at Risk, Hospital Admissions, and Hospital Days

Patients were followed from donor evaluation until death or last follow-up. Each day of follow-up was classified as being during one of four time periods: pre-transplant, first year post-transplant, second year post-transplant, third year post-transplant and beyond. For patients who did not receive a transplant, all time was classified as pre-transplant. For patients who did receive a transplant, the pre-transplant period was defined to end 2 days before the transplant. This 2-day period encompassed the most scheduled admission days immediately prior to elective LDLT. The two days before transplant were not included in any group. The first year post-transplant period began on the day of transplant, and ended 365 days after transplant. Each day in the hospital was also classified in the same way.

Admissions were classified based on admit date in a similar fashion, with the following two exceptions. Hospitalizations spanning the donor evaluation date were counted as admissions in the period corresponding to the donor evaluation date. Any admission that included the transplant date was classified as a first year post-transplant admission. If this admission started more than 2 days before the day of the transplant, the admission was also counted as a pre-transplant admission.

The total number of days in the hospital, number of hospital admissions, and days at risk were calculated for each time period and patient. Days and admissions were further subdivided into biliary and non-biliary days and admissions. Days were also separately subdivided into intensive care unit (ICU) and non-ICU days.

Both the admission and discharge dates were counted as a day in the hospital. Only those days between the first donor evaluation and end of follow-up were included in the counts of days. Days in the ICU were assumed to be distributed evenly across the hospitalization period since the specific dates of ICU care within hospitalizations were not captured.

Rates of Hospital Admission and Hospital Days

Overdispersed Poisson regression models were used to calculate adjusted rates of admission and rates of hospital days per patient-year at risk. Models were fit for all patients to calculate rates of hospital admission and hospitalization days for the entire period from donor evaluation to end of follow-up, with a covariate for whether the patient eventually received an LDLT or not. Models were adjusted for recipient age, MELD, and hepatocellular carcinoma (HCC) at enrollment for all periods. Results are presented as rates and 95% confidence intervals (95% CI).

Separate models restricted to patients who eventually received a transplant were fit predicting hospital admission rates and hospitalization days rates for each transplant type (DDLT, LDLT) and time period (pre-transplant, first year post-transplant, second year post-transplant, third year post-transplant and beyond). Similar models restricted to patients who eventually received a transplant were fit, further dividing the LDLT group into LDLT when the center was less experienced and LDLT when the center was more experienced. These models were also adjusted for recipient age, MELD, and diagnosis of HCC at enrollment for pre-transplant periods and recipient age, MELD, and HCC at transplant for post-transplant periods.

Similar models restricted to patients who eventually received a transplant were fit predicting biliary admissions and biliary days for each transplant type and time period.

Model estimates presented graphically represent a modal patient at the covariate means for the following characteristics: recipient age (50 years), MELD score (16), and HCC diagnosis probability (16%).

All analyses were carried out using SAS 9.1 software (SAS Publishing, Cary, NC: SAS Institute Inc., 2004).

Human Subjects Protection

The study was approved by the Institutional Review Boards and Privacy Boards of the University of Michigan Data Coordinating Center and each of the nine participating transplant centers.

RESULTS

Among 806 candidates, 384 received LDLT, 215 received DDLT, and 207 received no transplant by end of study. The median time to any transplant among the 599 recipients was 64 days (LDLT: 55; DDLT: 113) with a range of 3 days to 4.2 years. Median post-transplant follow-up time was 898 days with a range of 1 day to 8.4 years. Characteristics of study subjects at enrollment (date of potential living donor history and physical) and/or at transplant, as appropriate, are shown in Table 1. Subjects in the LDLT, DDLT, and no transplant groups were generally similar. There were some statistically significant differences between eventual LDLT recipients when compared to DDLT and/or non-transplanted subjects. However, in many cases these differences were not clinically important. Of note, compared to LDLT recipients, DDLT recipients had significantly higher MELD scores at enrollment (17.4±6.9 vs. 14.9±6.4; $P<0.0001$) and at transplant (20.9±9.4 vs. 15.2±6.3; $P<0.0001$). A significantly higher proportion of DDLT recipients were hospitalized or in the ICU at the time of transplant (39.5% vs. 12.7%; $P<0.0001$). Significantly higher proportions of DDLT recipients had ascites, encephalopathy, or variceal hemorrhage at transplant, were receiving dialysis or were on a ventilator at the time of transplant, and had had prior transjugular intrahepatic portosystemic shunt (Table 1).

In addition to the 599 transplant hospitalizations, there were 485 pre-transplant admissions (251 among eventual LDLT or DDLT recipients and 234 among subjects who were never transplanted) and 1428 post-transplant recipient hospitalizations (Table 2). Mean unadjusted pre-transplant, transplant, and post-transplant lengths of stay for DDLT recipients were 5.8±6.3, 27.0±32.6, and 9.0±14.1 days, respectively (Table 2). The corresponding unadjusted length of stay for LDLT recipients were 4.1±3.7, 21.4±24.3, and 7.8±11.4 days, respectively. Mean length of stay for patients who did not receive a transplant was 8.8±10.3 days.

Unadjusted statistics regarding the transplant hospitalization, including days spent in the hospital leading up to the transplant, days from transplant to discharge, and total days spent in the ICU are shown in Table 3. DDLT recipients were hospitalized for more than twice as many days leading to the transplant when compared to LDLT recipients. The total number of days in the ICU during the transplant hospitalization was similar for LDLT and DDLT recipients. The mean number of days from transplant to discharge and the total number of ICU days during the transplant hospitalization were lower once centers had more experience (>20 LDLT). There was substantial variation in the median number of days from transplant to discharge. Interestingly, differences among centers tended to be consistent across transplant type (Figure 1).

Pre-transplant and post-transplant hospital admission rates per patient-year at risk were also lower after each center reached 20 LDLT cases compared to earlier LDLT cases, but were higher than DDLT rates in both cases (Table 4). The rates of hospital days per patient-year at risk were higher in the pre-transplant phase for DDLT recipients when compared to LDLT recipients, but were lower in the second post-transplant year and beyond, even when compared to LDLT when centers were more experienced.

Because LDLT and DDLT recipients differed with respect to demographic and disease severity characteristics, hospital admission and hospital days rates were also calculated adjusted to the average values across all recipients for age, MELD score, and HCC status at enrollment (Figure 2). Even after adjustment, DDLT recipients had significantly more hospital utilization before transplant and significantly less hospital utilization in the first year post-transplant. Compared to DDLT, recipients of LDLT performed when centers were less experienced had higher post-transplant admission rates and days hospitalized per patient year and these differences were all statistically significant with the exception of hospital days in the second post-transplant year (Figure 2). In contrast, by the second post-transplant year and beyond, hospital admission rates and the number of days hospitalized per patient year at risk for recipients of LDLT performed when centers were more experienced were similar to those of DDLT recipients.

Hospitalizations related to biliary complications after liver transplantation were common. Among LDLT and DDLT recipients, there were 235 and 52 post-transplant hospitalizations for biliary complications, respectively. The adjusted rates of hospital admission for biliary tract-related discharge diagnoses during the first two post-transplant years were significantly higher for LDLT recipients, regardless of center experience level (Table 5). By the third post-transplant year, biliary hospitalization rates among recipients of LDLT done after centers had performed more than 20 LDLT cases were similar to those after DDLT. In the first post-transplant year, the adjusted rates of hospital days were significantly higher for LDLT recipients, regardless of center experience, compared to DDLT recipients. Compared to DDLT recipients, LDLT recipients (regardless of center experience) also had higher adjusted rates of hospital days at later time points. These differences were not consistently statistically significant.

When compared to DDLT recipients, the adjusted rate of non-biliary admissions in the first post-transplant year was approximately 50% higher among LDLT recipients whose transplants were performed when centers had less LDLT experience (3.17±0.17 vs. 2.30±0.13 hospitalizations per patient-year at risk; $P<0.0001$). Once centers had more LDLT experience, the adjusted first-year hospitalization rate was similar to that observed for DDLT recipients (2.46±0.13 vs. 2.30±0.13; $P=0.38$). Non-biliary hospitalization rates after the first post-transplant year were not significantly different among the groups of recipients. An identical pattern was observed for the adjusted rates of non-biliary hospital days per patient-year at risk (data not shown).

In order to evaluate overall hospital utilization associated with pursuit of an LDLT, we fitted overdispersed Poisson regression models to determine factors significantly predictive of hospitalizations (pre-transplant and post-transplant) and of days hospitalized during the entire period of risk starting at study enrollment (when a potential living donor had a history and physical exam), and including all potential recipients regardless of whether they eventually received a transplant. Receipt of an LDLT, whether done when centers were less experienced or more experienced, was associated with a 27% higher overall hospital admission rate ($P<0.005$) than receipt of a DDLT or of no transplant (Table 6). The risk of being in the hospital on any given day was 18% and 21% higher for recipients of LDLT done when centers had less and more experience, respectively ($p=0.10$ and $p=0.07$, respectively) when compared to DDLT recipients and those who received no transplant.

DISCUSSION

Although mortality experience after LDLT for selected patients has been shown to be superior to that of candidates who continue to wait for DDLT (2), hospitalization rates for recipients of LDLT have not been comprehensively examined. In a major recent evaluation of resource utilization after liver transplantation using the National Inpatient Sample, Scarborough et al. reported declining transplant hospitalization length of stay after DDLT in recent years, but mentioned the dearth of information on subsequent inpatient hospital utilization (3). Moreover, while there has been one report comparing pre-transplant and post-transplant hospitalization rates in DDLT (1), relationships between LDLT and hospitalization rates compared to DDLT or comparing pre- and post-transplant rates among LDLT recipients have not been studied.

Background hospitalization rates for cirrhotics cannot be easily compared to the liver transplant population, since the latter are a selected subpopulation among patients with chronic liver disease. Reporting metrics are also different. For example, in an epidemiological study of hospitalization of cirrhotics, Noble et al. (4) and Nguyen et al. (5) reported discharges with a diagnosis of cirrhosis per 10,000 or 100,000 population, respectively, but did not examine the frequency of hospitalization (admission rates by subject) or the magnitude of health care resources as assessed by days of hospitalization per patient-year at risk. In a Danish study, Jepsen et al. reported that, in 2005, alcoholic cirrhotic men were hospitalized 1.5 times per patient per year and alcoholic cirrhotic women were hospitalized 1.2 times per patient year (6).

With respect to the transplant hospitalization itself, Brown et al. reported that DDLT recipients were hospitalized for 16 days in the absence of complications and 45 days if complications ensued (7). In the current study, recipients were hospitalized approximately 20 days after the transplant procedure, and there was not much difference between LDLT and DDLT. This is somewhat surprising, since DDLT recipients had more advanced disease than LDLT recipients at the time of transplant as measured by MELD score, encephalopathy, ascites, variceal hemorrhage, requirement for TIPS, and the need for dialysis or mechanical ventilation at the time of transplant, and were hospitalized for a greater number of days immediately in advance of the transplant procedure itself (5.8 vs. 1.5). There were notable differences among the nine A2ALL centers with respect to the number of days from transplant to discharge, although the relative differences among centers were fairly consistent across DDLT, LDLT during the period of less center experience, and LDLT during the period of more center experience.

Comparisons of the effect of liver transplantation on the need for hospitalization before and after the procedure help to define its role in reducing the overall burden of disease in patients with cirrhosis. An analysis of 215 DDLT recipients by Schaubel et al. used the

Pennsylvania Health Care Cost Containment Council database and found 4.2 to 12.6 pre-transplant hospitalizations per patient-year, depending on MELD category (1). In the MELD range comparable to subjects in the current study, the rates were between 4 and 6 per patient-year. These rates, which are higher than the pre-transplant hospitalization rates we report for patients who eventually received DDLT (2.2 per patient-year), likely reflect the higher disease acuity of the general pool of DDLT recipients, most of whom are never considered for LDLT (2). The rate of post-transplant hospitalization, for which data were largely available only in the first post-transplant year in the study by Schaubel et al., averaged about 2 per patient-year, which is fairly similar to that seen in the current study among DDLT recipients, but lower than that observed after LDLT.

We observed that LDLT recipients had significantly higher adjusted post-transplant hospitalization rates and days in the hospital when compared to DDLT recipients during the first post-transplant year. By the second year, hospital admission rates for DDLT and LDLT recipients were comparable among those transplants done after the center was more experienced (center LDLT case number >20). However, the number of days hospitalized per patient-year at risk remained significantly higher for LDLT recipients even at experienced centers. This suggests that after centers gain experience with the LDLT procedure, there are fewer late hospitalizations but those that occur are of longer duration. Thus, in addition to the demonstrations of a beneficial effect of center experience on mortality and recipient complications that have been previously described in the A2ALL cohort (8, 9), and a recent study that showed the effect on mortality to be generalizable to LDLT transplants done across the U.S. (10), this is the first demonstration of a learning curve effect on both pre- and post-transplant hospitalization in LDLT recipients.

Biliary tract morbidity remains a major unresolved issue in the practice of LDLT throughout the world (9, 11–20). For this reason, we focused on post-transplant hospitalization requirements related to biliary complications. In contrast to the overall reduction in inpatient hospital service utilization that accompanied greater LDLT experience and that observed for the subset of non-biliary admissions, rates of both hospital admission and days hospitalized remained significantly higher for LDLT recipients through follow-up periods exceeding three years, and only declined to rates similar to that seen after DDLT in the third post-transplant year among LDLT done after centers had performed more than 20 LDLT cases. Clearly, long-term biliary tract complications after LDLT deserve more careful scrutiny, with a view toward reducing their incidence and improving management.

Separate analyses of pre-transplant and post-transplant hospitalization rates are helpful in evaluating the resource demands of liver transplantation and can provide valuable insight for prospective transplant candidates. However, as our analyses demonstrated, LDLT recipients had significantly less hospitalization prior to transplant and significantly more hospitalization afterward. Thus, from the perspective of a patient considering LDLT, an integrated view of the need for and magnitude of hospitalization services from that starting point is very useful. Poisson regression models that incorporated all hospital admission experience starting at the time of potential donor history and physical examination, regardless of whether or which type of transplant was eventually performed, allowed us to demonstrate clearly that LDLT recipients had more than 25% higher overall odds of hospital admission and were 20% more likely to be hospitalized on any given day, when compared to patients who either received a later DDLT or did not end up with a transplant at all. Importantly, more LDLT experience at the transplant center did not ameliorate these excess overall hospitalization utilization rates.

In conclusion, LDLT is associated with significantly reduced mortality when offered to patients with chronic liver disease, but is accompanied by a markedly higher need for

inpatient hospitalization. Biliary morbidity after LDLT remains a major driver of higher hospitalization utilization in this patient population.

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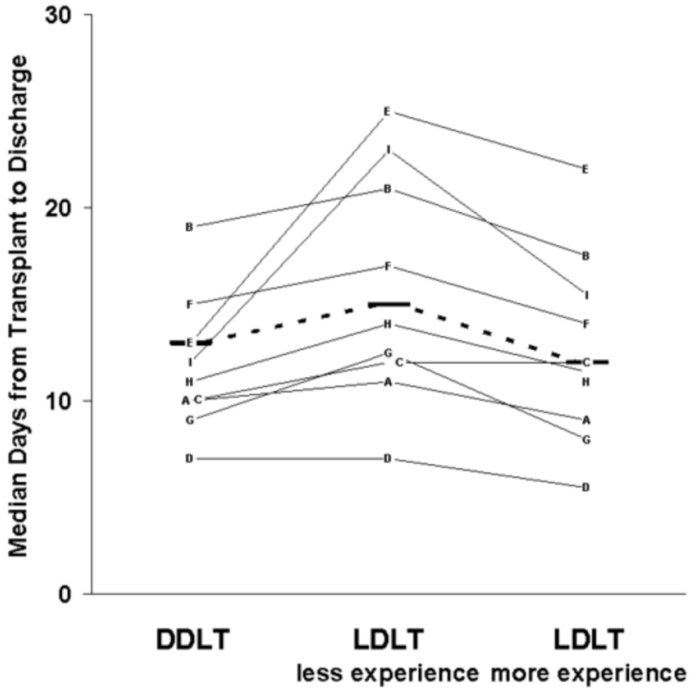

Figure 1.
Median number of days from transplant to discharge by center and transplant type. Dark bars and dashed line represent overall median.

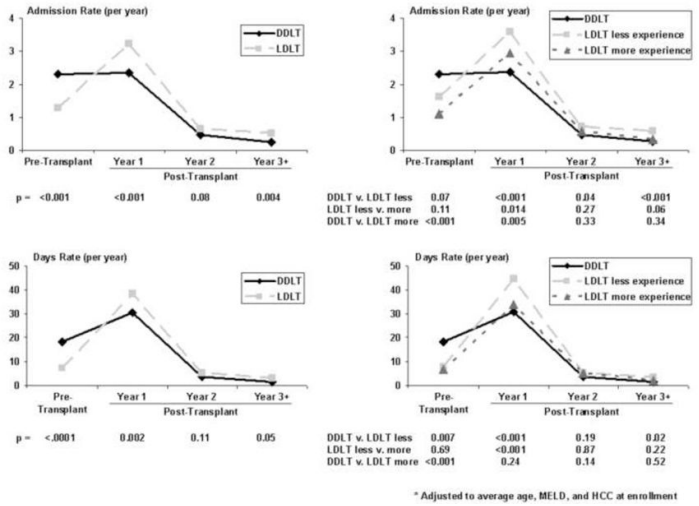

Figure 2.
Adjusted admission and hospital days rates by transplant type and timing of hospitalization relative to transplant procedure.

Table 1

Characteristics of subjects in the cohort.

Characteristic	LDLT (N=384) mean ± s.d. or %	DDLT (N=215) mean ± s.d. or %	No Transplant (N=207) mean ± s.d. or %
Age	49.3 ± 10.7	50.9 ± 9.6	51.6 ± 9.3 *
Race			*
White	90.6	88.4	89.9
Black	3.1	5.6	7.7
Other	6.3	6.0	2.4
Missing	0.0	0.0	0.0
Hispanic	19.3	18.6	19.8
Female	42.2	40.5	47.8
Diagnosis			
Cholestatic	18.5	18.1	19.8
Malignancy (non-HCC)	2.3	1.4	1.9
Metabolic	2.9	3.3	2.9
Non cholestatic cirrhosis (non-hepatitis C)	20.8	22.3	17.4
Hepatitis C virus cirrhosis	47.9	47.4	46.4
HCC	15.1	15.8	6.3 *
Alcohol related	13.5	14.9	15.0
Other	3.4	1.9	5.3
Height	171.4 ± 10.8	171.6 ± 10.3	170.0 ± 9.3
Weight	78.6 ± 18.0	79.7 ± 18.0	81.4 ± 18.0
BMI	26.7 ± 5.2	26.9 ± 4.9	28.0 ± 5.5 *
Previous Liver Transplant	2.3	0.5	2.4
MELD at Enrollment	14.9 ± 6.4	17.4 ± 6.9 *	15.0 ± 7.2
MELD at Transplant	15.2 ± 6.3	20.9 ± 9.4 *	-
Medical Condition at Transplant		*	
ICU	1.8	17.2	-
Hospitalized not in the ICU	10.9	22.3	-
Not Hospitalized	87.2	60.5	-
Unknown	0.0	0.0	-
Ascites prior to Enrollment	61.2	68.8	67.6
Ascites at Transplant	57.8	74.0 *	-
Encephalopathy prior to Enrollment	40.6	52.1 *	57.5 *
Grade 3/4 Encephalopathy at Transplant	10.9	34.4 *	-
On Dialysis at Enrollment	3.1	2.3	3.4
On Dialysis at Transplant	1.3	6.5 *	-
Variceal Bleed prior to Enrollment	16.9	17.2	20.3
Variceal Bleed at Transplant	0.5	2.8 *	-

Characteristic	LDLT (N=384) mean ± s.d. or %	DDLT (N=215) mean ± s.d. or %	No Transplant (N=207) mean ± s.d. or %
SBP prior to Enrollment	7.6	7.4	3.9
SBP at Transplant	3.4	6.0	-
History of TIPSS at Enrollment	8.6	14.9 *	9.7
History of TIPSS at Transplant	8.6	16.3 *	-
On Ventilator at Enrollment	0.8	0.9	1.4
On Ventilator at Transplant	1.3	7.0 *	-
Days from Listing to Enrollment	215.8 ± 306.0	253.5 ± 315.6	282.4 ± 387.9 *
Days from Enrollment to Transplant	85.0 ± 104.3	204.0 ± 242.1 *	-
Cold Ischemia Time (min)	89.8 ± 100.7	469.0 ± 180.8 *	-

* $p<0.05$ vs LDLT

Table 2

Number and duration of hospitalizations. Results are presented as mean ± s.d.

	Number of Admissions by Hospitalization Type		
Patient Group	**Pre-Transplant**	**Transplant**	**Post-Transplant**
All	485	599	1428
LDLT	63	384	1048
LDLT less experience	26	167	576
LDLT more experience	37	217	472
Non LDLT	422	215	380
DDLT	188	215	380
No Transplant	234	-	-
	Average Days Per Admission by Hospitalization Type		
Patient Group	**Pre-Transplant**	**Transplant**	**Post-Transplant**
All	7.0 ± 8.4	23.5 ± 27.7	8.1 ± 12.1
LDLT	4.1 ± 3.7	21.4 ± 24.3	7.8 ± 11.4
LDLT less experience	3.7 ± 2.1	23.3 ± 20.5	7.7 ± 11.1
LDLT more experience	4.4 ± 4.4	20.0 ± 26.8	7.8 ± 11.7
Non LDLT	7.4 ± 8.9	27.0 ± 32.6	9.0 ± 14.1
DDLT	5.8 ± 6.3	27.0 ± 32.6	9.0 ± 14.1
No Transplant	8.8 ± 10.3	-	-

Table 3

Transplant hospitalization. Results are presented as mean ± s.d.

Patient Group	N	Days Before Transplant	Days From Transplant to Discharge*	Total Days in ICU
All	599	3.1 ± 7.7	20.4 ± 24.8	7.6 ± 17.0
LDLT	384	1.5 ± 3.7	19.9 ± 23.7	6.7 ± 16.6
LDLT less experience	167	1.5 ± 3.3	21.8 ± 19.8	7.8 ± 13.3
LDLT more experience	217	1.5 ± 3.9	18.5 ± 26.2	5.8 ± 18.8
DDLT	215	5.8 ± 11.5	21.2 ± 26.8	9.4 ± 17.4
Not transplanted from ICU				
LDLT	377	1.4 ± 3.5	19.8 ± 23.7	6.3 ± 16.4
DDLT	178	3.8 ± 10.4	16.9 ± 15.6	6.1 ± 10.0
Transplanted from ICU				
LDLT	7	6.9 ± 6.6	27.0 ± 21.7	25.5 ± 17.9
DDLT	37	15.3 ± 11.9	42.3 ± 50.1	25.0 ± 31.8

*includes day of transplant

Table 4

Unadjusted admission and hospital days rates (per patient-year at risk). Results are presented as mean ± s.e.

	Time Period Relative to Transplant			
		Post-transplant		
	Pre-transplant*	Year 1**	Year 2	Year 3+
Hospital Admission Rates				
DDLT	2.2 ± 0.17	2.6 ± 0.15	0.50 ± 0.08	0.30 ± 0.06
LDLT	1.2 ± 0.15	3.2 ± 0.12	0.64 ± 0.06	0.53 ± 0.05
LDLT less experience	1.6 ± 0.29	3.5 ± 0.19	0.72 ± 0.09	0.62 ± 0.07
LDLT more experience	1.1 ± 0.17	2.9 ± 0.15	0.55 ± 0.08	0.35 ± 0.08
Hospital Days Rates				
DDLT	17.8 ± 1.8	38.2 ± 2.1	4.3 ± 0.9	2.1 ± 0.6
LDLT	6.8 ± 1.3	38.3 ± 1.5	5.1 ± 0.6	3.3 ± 0.5
LDLT less experience	7.7 ± 2.4	44.8 ± 2.6	5.2 ± 0.9	3.9 ± 0.7
LDLT more experience	6.3 ± 1.6	33.5 ± 1.9	5.1 ± 0.9	2.1 ± 0.7

* Admission rates include transplant admissions that start more than 2 days before transplant; days rates exclude 2 days before transplant.

** Admission rates include the transplant admission; days rates include day of transplant.

Table 5

Adjusted post-transplant biliary admission and days rates*. Rates are presented as mean ± s.e.

	Year 1**	Year 2	Year 3+
Adjusted Biliary Admission Rates			
DDLT	0.22 ± 0.03	0.06 ± 0.02	0.02 ± 0.01
LDLT less experience	0.40 ± 0.05	0.17 ± 0.03	0.20 ± 0.03
LDLT more experience	0.46 ± 0.04	0.19 ± 0.03	0.01 ± 0.01
p-values			
DDLT vs. LDLT less experience	0.0024	0.0076	<0.0001
LDLT less experience vs. LDLT more experience	0.35	0.75	0.0023
DDLT vs. LDLT more experience	<0.0001	0.0034	0.55
Adjusted Biliary Days Rates			
DDLT	1.53 ± 0.23	0.59 ± 0.17	0.09 ± 0.06
LDLT less experience	3.20 ± 0.37	0.75 ± 0.19	0.89 ± 0.17
LDLT more experience	3.47 ± 0.33	1.10 ± 0.22	0.13 ± 0.10
p-values			
DDLT vs. LDLT less	0.0001	0.55	0.0025
LDLT less experience vs. LDLT more experience	0.59	0.23	0.0122
DDLT vs. LDLT more experience	<0.0001	0.08	0.71

* Rates adjusted to average age, MELD, and HCC at enrollment

** Includes day of transplant

Table 6

Overdispersed Poisson regression models for overall rates of hospital admissions and days starting at date of potential donor history and physical examination.

	Hospital Admissions			Hospital Days		
Model Covariate	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Recipient Age at Enrollment (per 10 years)	1.03	(0.96, 1.10)	0.40	1.11	(1.02, 1.20)	0.015
MELD at Enrollment (per 1 unit)	1.03	(1.02, 1.04)	<0.0001	1.04	(1.03, 1.05)	<0.0001
HCC at Enrollment	1.15	(0.93, 1.41)	0.19	1.02	(0.78, 1.34)	0.89
LDLT less experience (vs. DDLT+no transplant)	1.27	(1.08, 1.49)	0.004	1.18	(0.97, 1.45)	0.10
LDLT more experience (vs. DDLT+no transplant)	1.27	(1.08, 1.50)	0.004	1.21	(0.99, 1.48)	0.07